PRS-NEOWEB™ Cellular Confinement System

Stabilizing an unstable world!

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Comparison with Geogrids

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Introduction

This document compares geogrid based solutions with the Neoloy® based PRS-Neoweb™ solution from PRS for reinforcement in load support applications, such as flexible pavement structures in paved and unpaved roads, working platforms and track substructures, as well as earth retention structures.

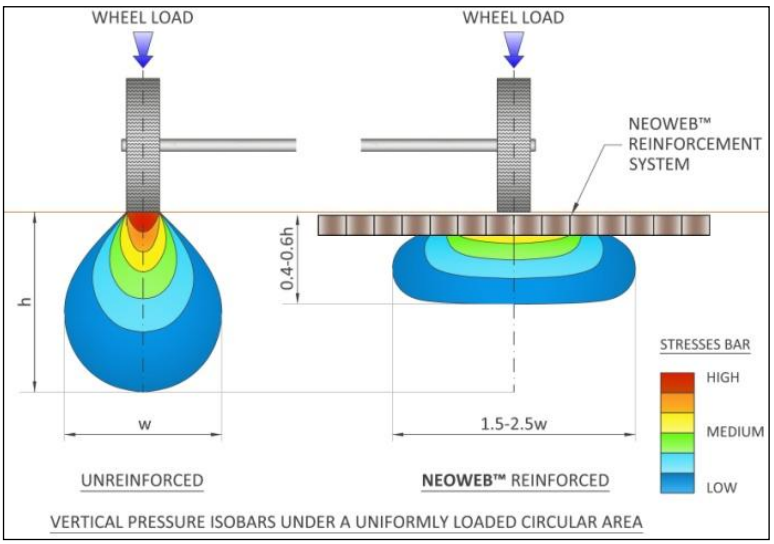
Geogrids

Geogrids are polymeric structures or manufactured sheets, formed into a matrix with large apertures between individual ribs, linked by extrusion, bonding or interlacing. These are typically stretched in one (unidirectional) or two directions (bidirectional) for improved physical properties. Geogrids are used as reinforcement materials in geotechnical, environmental, hydraulic and transportation engineering applications.

PRS-Neoweb Cellular Confinement System

The PRS-Neoweb cellular confinement system is a 3D honeycomb structure, which forms a composite system when filled with soil to stabilize and reinforce soft soils. Typical applications include: load support for paved/unpaved roads, railways; slope and channel erosion protection; earth stabilization and retention; and landfills and reservoirs.

Vertical loading on the PRS-Neoweb confined cells creates a semi-rigid slab or "**beam effect**" over soft soils. This distributes the load evenly and effectively over a wider area, while increasing bearing capacity and decreasing differential settlement.



The enhanced 3D properties of PRS-Neoweb and its reinforcement capabilities enable a reduction in the thickness of structural pavements – both the substrata and asphalt layers – while at the same time improving the performance of non-cohesive, inferior fill, such as fine granular soils and recycled materials.

These benefits decrease the amount of excavation, hauling, and aggregate placement and compaction resulting in significant economic and environmental gains. Reinforcement with PRS-Neoweb also increases the service life of pavement structures, thereby reducing their operational and maintenance cost requirements. This enables transportation management professionals to allocate the budgets from maintenance and repair to the construction of new roads and infrastructure.

New Generation Neoloy® Based PRS-Neoweb ™

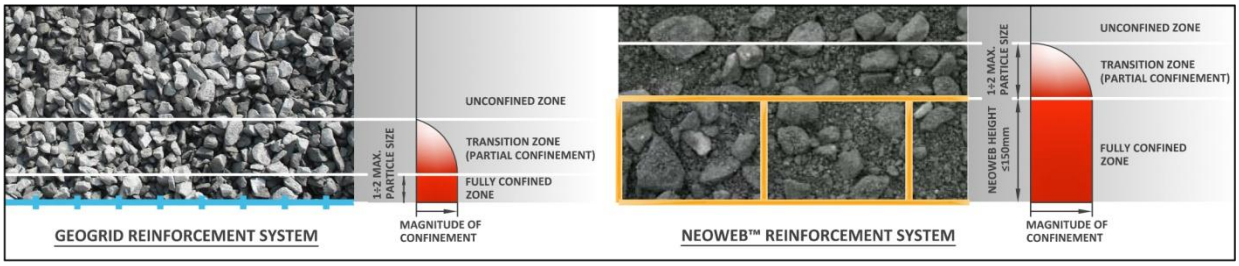
PRS-Neoweb is based on a patented Neoloy polymeric alloy that combines the creep resistance of polyesters with the ease of installation and low temperature flexibility typical of HDPE. PRS-Neoweb resistance to creep, oxidation and long-term UV light exposure substantially extends the design life of the geocells, and therefore the engineering performance and life-span of the project as well.

The ability to predict and guarantee the long term performance of PRS-Neoweb aligns it with the typical life-span required by civil engineering projects. This makes PRS-Neoweb the most suitable reinforcement solution for a wide range of load support applications including roads, railways, airports, parking, pipelines, and working platforms, in addition to traditional earth stabilization applications, and provides a clear value proposition compared to geogrids, other geocells, or other reinforcement geosynthetics.

Comparative Confinement Zones

PRS-Neoweb Confinement vs. Geogrids

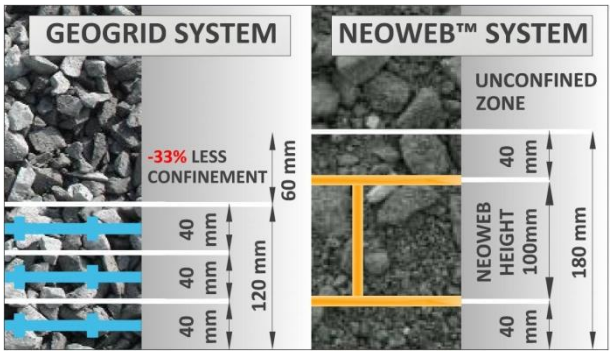
The reinforcement capabilities of PRS-Neoweb 3D cellular confinement system are another significant advantage over 2D geogrids. Geogrids require a specific graded aggregate, and cannot be larger than half the grid aperture. This limits the confinement zone of geogrids to a maximum of 4 cm, as shown in the illustration below.



The PRS-Neoweb fully confined zone is equivalent to the height of the cell. In addition the particle size is limited to 1/3 of the cell diameter, which is many times larger than geogrid apertures.

3D Confinement Enables Use of Less Expensive Infill

PRS-Neoweb 3D cellular confinement system exhibit clear advantages over 2D planar solutions (geotextiles, geogrids). 3D PRS-Neoweb cellular confinement systems can utilize fine grained granular materials that are unusable by 2D geogrids. For example, non-cohesive material such as sand attains sufficient strength and stiffness when confined in geocell encased soils (Rajagopal, Krishnaswamy, and Madhavi Latha 1999).



The 3D vertical confinement zone enables the use of less expensive local and/or ungraded granular materials for infill. This includes native soil, quarry waste, sand, RAP (Recycled Asphalt Pavement) and recycled construction waste for such load support applications. Depending on the project-specific soil conditions and traffic loading parameters, PRS-Neoweb can offer very large cost savings by using these inferior infill sources.

Comparison Table

Resistance and Dimensional Stability

TOPIC	PRS-NEOWEB	GEOGRID
Resistance-deformation	Highly elastic behavior (resistance) before reaching high deformation	Small resistance at small deformation
Durability under cyclic dynamic loads	Vertical loads are translated to radial loads that are translated to hoop stress in geocell walls for very high dimensional stability and structural integrity	High level of deformation
Resistance zone	Resistance is achieved in a the three-dimensional “plane”	The resistance is limited to a thin plane, in one or two directions
Bending moment resistance	Depth of layer provides an increased bending moment resistance effective to at least the height of cell walls. Additionally the structural resistance and integrity of the PRS-Neoweb solution provides a better performance under concentrated or ”point” loads	Almost no resistance. Geogrids require a minimum of two layers to create a planer composite before gaining minor Bending Moment Resistance
Vertical soil interface friction	Large interface area of highly textured and perforated cell walls	Small height of active area
Lateral deformation	Lateral stresses on the cell walls are confined by stiff cell walls, while the passive earth resistance of adjacent cells provides additional resistance against the loaded cell. The result is a stiff beam with high bearing capacity.	The limitation of the lateral expansion is restricted to a very small section (unless the Geogrid can be used in a “wrap-around” fashion).
Stress and settlement	PRS-Neoweb distributes the surface load though the three-dimensional beam or semi-rigid slab as a unit, reducing stresses transferred to the subgrade by up to 50%. Also as the stress is more uniformly distributed in the mattress, total and differential settlements are greatly reduced.	Geogrids only respond to loading within a small effective radius. The load is distributed over a smaller area, and thus, the stress increases as does the possibility of total or differential settlements

Infill Soil Types, Soil Retention, Drainage

TOPIC	PRS-NEOWEB	GEOGRID
Reinforced/retained soils	Accepts a wide variety of soils, even inferior or poorly graded granular materials	Requires specific quality (and high-cost) aggregate fill type
Retained soil improvement	Improves the apparent cohesion of the soil, which significantly increases its resistance to imposed loading.	The improved area has a limited vertical range
Performance with abraded soils	Three-dimensional confinement reduces aggregate abrasion and attrition	Reduces attrition only if used with specific granular and graded soil
Drainage performance	Retains soil particles in a multi-axial range, thus allowing the natural passage of liquid flows in any direction while preventing those flows from leaching away the retained soil particles.	Retains soil particles in only thin layer consistent with its planer dimension. Liquid flows can easily leach soil particles away in all other directions.

PRS-Neoweb vs. Geogrids –Field Trial

Testing Organization

KOAC–NPC (Netherlands) is a leading independent specialized institute for testing, research and consultancy in civil engineering, with emphasis on road construction elements;

Report

Van Gurp, C.A.P.M., Westera, G.E. (2008) "*Geogrid Trial Road Base NL 2008*", KOAC-NPC, Final Report.

Introduction

KOAC conducted controlled field trials for geosynthetics reinforcement of road bases. Test data was based on deformation and stiffness trials of full-scale structures in controlled sites (enclosed hangars). PRS-Neoweb was the only geocell manufacturer among 7 world-leading geogrid manufacturers. In addition PRS-Neoweb was also the only geosynthetic that could be tested with inferior aggregate as road base infill.

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Description

Falling Weight Deflectometer (FWD) loading created vertical deformation "footprints", which were used to assess the stiffness moduli. The results are based on the stiffness modulus of the combination of subbase and subgrade and the geosynthetic reinforcement in order to derive the road base thickness reduction factor. The design chart/method was developed by KOAC-NPC for CROW (the Netherlands Technology Institute for Transport, Infrastructure and Public Space).

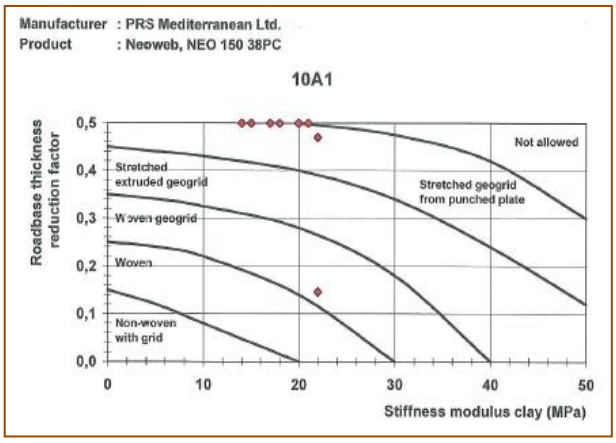

Figure 2. Roadbase Reduction Factor for PRS-Neoweb (limited)

Results

The calculated mean road-base thickness reduction factor (unlimited) for PRS-Neoweb with a subgrade CBR of 1.5 was 73%. This is literally off the scale, higher than any published values for comparable geosynthetic reinforcement. Whereas geogrids have never demonstrated values higher than 0.5, KOAC set this value as the maximum limit for all tested products. Even within these limitations, the mean 47% reduction factor for PRS-Neoweb is significantly higher than all other tested products.

Roadbase thickness reduction factor station 10A1

Control section	Station	Roadbase thickness reduction factor	NO LIMIT Roadbase thickness reduction factor	Stiffness clay control
(-)	(-)	(-)	(-)	(MPa)
Section 1B	1B2	0,50	0,77	15
Section 1B	1B4	0,50	0,88	15
Section 3B	3B1	0,50	0,87	14
Section 3B	3B2	0,50	0,76	14
Section 4C	4C2	0,50	0,63	18
Section 4C	4C3	0,50	0,76	18
Section 5A	5A1	0,50	0,72	17
Section 5A	5A2	0,50	0,74	17
Section 5B	5B2	0,50	0,81	20
Section 5B	5C3	0,50	0,83	20
Section 6B	6B1	0,50	0,96	21
Section 6B	6B2	0,50	0,83	21
Section 8C	8C1	0,15	0,15	22
Section 8C	8C2	0,47	0,47	22
	Minimum	0,15	0,15	
	Maximum	0,50	0,95	
	Mean	0,47	0,73	

Figure 1. Actual Roadbase Thickness Reduction Factors (limited vs. unlimited)*

Conclusion

- Only product to be tested with inferior infill
- Highest Road Base Thickness Reduction Factor of any tested product (limited and unlimited)
- High quality infill – avg. 43% * *(* Values limited to max. of 50% by testing organization)*
- Inferior quality infill – 31.5% * *(* Values limited to max. of 50% by testing organization)*
- PRS-Neoweb performance above and beyond geogrid capabilities

Summary

PRS-Neoweb from Neoloy is an innovative 3D soil reinforcement technology that improves strength, reduces costs, and minimizes maintenance better than 2D geogrids; including:

- Load resistance and elastic response, with zero plastic deformation after millions of cyclical and dynamic cycles
- Eliminates requirements for high quality specific graded soil
- Extends the envelope of useable infill material to include inferior granular material, including sand, quarry waste and recycled materials
- Reduces deformation and total or differential settlements
- Reduces aggregate abrasion and attrition from heavy trafficking
- Significantly reducing erosion from hydraulic forces
- Durability and performance in the context of extreme or changing thermal conditions.
- Green solution that reduces carbon footprint

All of the above contribute to the PRS-Neoweb solution being more economical, especially when maintenance & repair costs are included in the life-time cost analysis.

Additional Advantages of PRS-Neoweb

Neoloy's excellent mechanical, physical and chemical engineering properties are demonstrated by its long-term resistance to creep, oxidation, UV light exposure, and the effects of temperature extremes (high dimensional stability). The very low Coefficient of Thermal Expansion (CTE) - 80 ppm^{o}C extends the design life of Neoloy based PRS-Neoweb well beyond conventional solutions and provides a clear value proposition compared to all other geocells, geogrids and geosynthetics.

Single Integrated Solution

Neoloy gives engineers a single soil stabilization strategy for an entire infrastructure project. In addition to subgrade improvement, Neoloy provides earth stabilization and slope/channel protection for embankments, retaining walls, roadscapes, flyovers, and stream diversions, typical of large-scale transportation and civil engineering projects.

Durability

PRS-Neoweb is comprised of advanced polymeric alloys that make the cellular confinement system stiff, flexible and durable. In particular the PRS-Neoweb patent-pending alloys feature long term dimensional stability high long term design strength (creep resistance) and low reduction factors. This translates to a longer life-span for PRS-Neoweb based structures. In addition, PRS-Neoweb is non-degradable and is resistant to weathering, extreme temperatures and water.

Sustainable Solution

PRS-Neoweb is a green and sustainable construction solution that minimizes environmental impacts and extends project life-spans – the result is additional savings in time, money and resources. The ability to use inferior quality soil for infill saves aggregate resources and reduces the number of haul vehicles, which in turn, lowers fuel usage, the carbon footprint and project costs.

PRS

PRS is the world's leading supplier of cost-effective earth stabilization solutions. Combining unique proprietary technology with specialized engineering expertise, PRS delivers proven solutions for load support, slope and channel protection, earth retention, and reservoir and landfill applications. With a global network of regional offices and local distributors, PRS provides a full range of end-to-end support services. Since its establishment in 1996, PRS has implemented hundreds of successful projects in over 40 countries worldwide.

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